5 Ways to Find True North

You can rarely rely on magnetic north to accurately align your antenna. Here's how to get pointed in the right direction.

Ron Berry, WB3LHD

1 Compass Method

If you use the compass method, you must first compensate for your location's magnetic declination (see the sidebar, "Compensating for Declination"). When your compass needle points north, it is pointing at *magnetic north* (a point in northern Canada where northern lines of attraction enter Earth, responding to its magnetic field), not *true north* (geographically, the North Pole). If you don't have a standard compass, there are many GPS devices and smartphone apps that show magnetic declination and true north directions for your location.

A National Oceanic and Atmospheric Administration website (**www.ngdc.noaa.gov/geomag-web/#declination**) makes easy work of finding your declination. Just enter your address and the calculator will fill in the latitude, longitude, and date. Then hit **CALCULATE** and the calculator will use the default World Magnetic Model — which uses the geomagnetic field to standardize navigation, attitude, and heading reference networks — to determine your magnetic declination. The result is shown as a compass overlying a map of your local area.

For my location, the calculator shows magnetic north (MN) pointing 9° 10' west of true north. To get a true north heading, I must add 9.17° in the easterly direction (see Figure 1A).

Compensating for Declination

In the United States, magnetic north varies from –19° (westward error) in Maine to +18° (eastward error) in Washington state. This error is known as *magnetic declination*. World maps, however, are based upon geodetic (i.e., true) north, so to accurately align your antenna, you must compensate for your local magnetic declination. The DXCC Country List at **ok2pbq.atesystem.cz/prog/dxcclist.php** provides helpful coordinates to navigate this.

Compensation is simple: for a west (negative) declination, add its absolute value to your compass reading; for an east (positive) declination, subtract it from your compass reading.

You may not get your antenna aligned to true north exactly, but most antenna beamwidths are broad enough that you will not see much difference with headings a few degrees off. But remember, if you're in a location with a high magnetic declination, aligning your antenna to true north is critical. Declination error is calculated at 100 feet/degrees/miles, so if you live in a location with an 18° declination and align your antenna to magnetic north, then try for an 8,000-mile DX contact, you will be off target by over 2,700 miles!

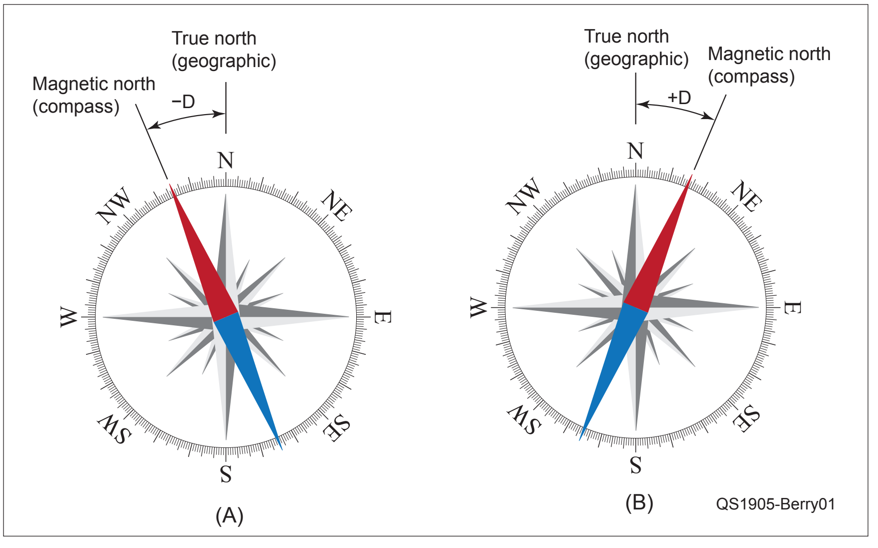


Figure 1 — At (A), the absolute value of a westward declination must be added to the heading shown by the needle (colloquially known as *red Fred*) to determine true north; at (B) for an eastward declination, the declination is subtracted from the magnetic heading to determine true north.

If you have an easterly magnetic declination, you would subtract your declination degrees in the westerly direction to get the true north heading (see Figure 1B). Better compasses have an adjustment bezel to compensate for east and west declinations. Once the declination is set, your compass headings will always reference from true north.

Assuming that you have a better compass and that it's now compensated for declination, you can check your antenna's true heading. Your compass dial will have an orientating arrow pointing straight out that is colloquially referred to as 'the shed," along with the red part of the magnetic needle called "red Fred." Turn your compass dial to "put red Fred in the shed" — or align the magnetic needle with the orienting arrow (see Figure 2). While keeping the needle in that position, sight down the compass in the direction your antenna is pointing and read the heading. An orienteering compass makes this easier to do.

Equipment

If you are looking to buy a new or first compass, some good names are Brunton, Silva, and Suunto. Try a mirrored orientating compass, which makes it easier to see where your antenna is pointed. I also recommend a compass with a declination setting adjustment. Once you set your location's declination, you won't have to worry about it again. Remember, if you move to another location, you may need to readjust the declination for that area. For this article and testing, I used a Brunton TruArc 20 compass.

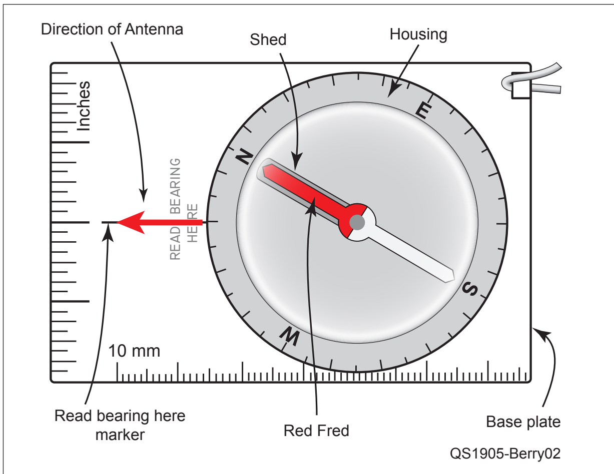
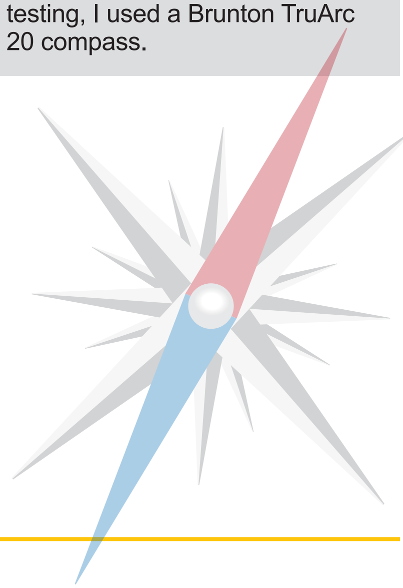


Figure 2 — A baseplate compass, which is handy for working with topographic maps. The compass heading is determined by rotating the housing ring to align the box associated with north (the *shed*) with the generally red half (*red Fred*) of the magnetic north seeking compass needle, colloquially referred to as *putting red Fred in the shed*.



2 Map Method

If you have a baseplate compass, you can use a US Geological Survey (USGS) topographical map (available at **www.usgs.gov/products/maps/topo-maps**). Orient your map and compass to true north and take a heading with your compass to an object you can see. There is an excellent video explaining how to do this at **www.youtube.com/watch?v=a2aGiUl1u4c**.

The magnetic declination information and true north direction for the local area are generally located at the bottom of the map. Because the Earth's magnetic field is constantly changing, use this declination only if the map is current. You may see a variation of Figure 3 on your map. The star symbol line is always the direction of true north. The magnetic north direction is shown with the harpoon line. Note the westerly magnetic declination number listed as 7° 36' from true north. There may also be a third directional line called "grid north," sometimes abbreviated as GN. The grid lines are references used for navigating on the map with your baseplate compass.

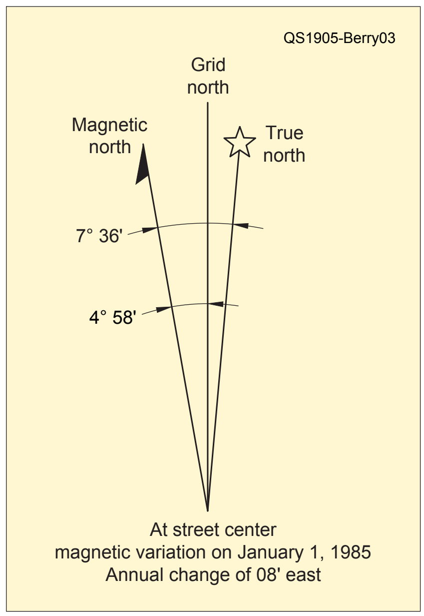


Figure 3 — Magnetic declination specification, generally located at the bottom of topological maps.

3 Star Method

Presently, Polaris, the North Star, is very close to true north and is routinely used for celestial navigation. In the constellation Ursa Minor, Polaris is the end "tail" star, and brightest of the seven stars in the Little Dipper. It may be difficult to identify or see clearly on all nights from urban skies (see Figure 4).

For stations south of the equator, Polaris is not visible, so you must find true south using the Southern Cross and the two Pointer stars, Alpha and Beta Centauri, in the constellation Crux (see Figure 5).

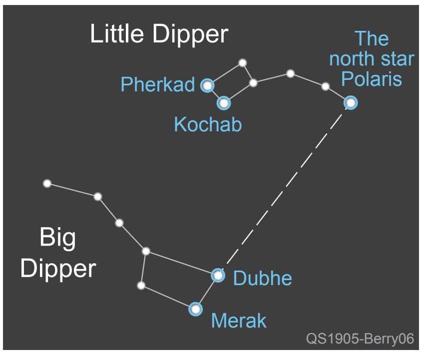


Figure 4 — A Northern Hemisphere star map for locating the North Star, Polaris, using the two pointing stars Merak and Dubhe in the ladle portion of the Big Dipper constellation.

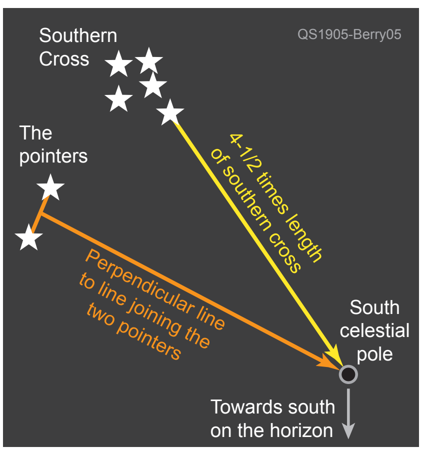


Figure 5 — A Southern Hemisphere star map used for locating the celestial south pole.

4 Shadow Method

On a sunny day, get a straight pole a few feet long and stick it in the ground as straight up and down as possible. At the tip of the pole's shadow, place an object like a small stone as a marker. This first stone is the westerly point. Wait about a half hour or more so there is a good spacing between the shadows and place another stone at the tip of the shadow again. This stone is the easterly point.

Placing a straightedge across the two stones forms an east-west line. Placing another straightedge perpendicular to the east-west line forms a north-south line with the end away from the vertical pole pointing to true north (see Figure 6). Align your antenna north with the boom parallel with the north-south straightedge. You must be sure you can see the shadow alignment sticks from your antenna view. Note that this method will be more accurate if the west and east points are marked in the morning and afternoon and are equidistant from the vertical pole.

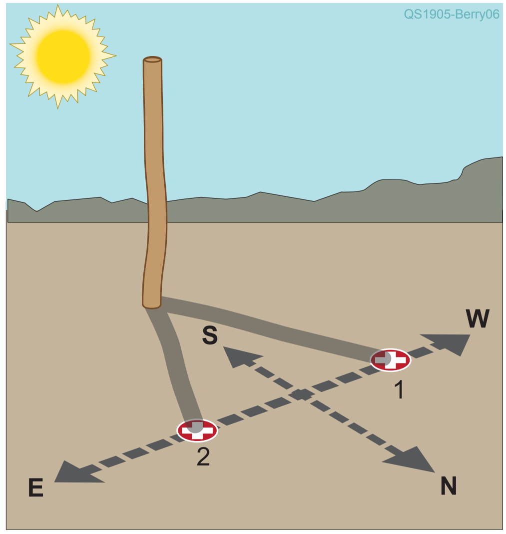


Figure 6 — Using the sun's shadow from a vertical pole to determine true north.

5 Solar Method

An online calculator that displays the sun's azimuth according to the time at your location is available at **planetcalc.com/4270/**. Enter your latitude, longitude, hours from GMT, and date. Hit the **CALCULATE** button and it will display the sun's azimuth in degrees for every hour of the day (24-hour format). Now set your rotator to the azimuth reading according to the time and go outside to see if your beam is pointing in the sun's direction.

Be careful not to blind yourself looking directly at the sun. This won't work very well on cloudy or overcast days, as the sun's actual location may be visually skewed. This calculator is good for checking your antenna system from time to time to make sure nothing has gone askew.

Forty-year ARRL member Ron Berry, WB3LHD, holds a 20 WPM Amateur Extra-class license and is a member of the International DX Association (INDEXA) and the Six Meter International Club (SMIRK). He is on the DXCC Honor Roll and needs only three entities to achieve DXCC #1. Ron graduated from electronics school in 1969 with a degree in electronics technology. He has been an electronics technician for 47 years working in the TV broadcast industry with ITS Corporation, ADC Telecommunications, Axcera LLC, and GigaHertz LLC in engineering. Ron's main interest is working DX using CW, SSB, RTTY, and various digital modes. Two of his most memorable events were visiting ARRL headquarters station W1AW in 1994 and operating RTTY from his home station as W1AW/3 in the 2014 ARRL Centennial Celebration. You can contact Ron at **wb3lhd@arrl.net**.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.